

What is claimed is:

1. A medical imaging system for conducting an image-guided medical procedure on a subject, the system comprising:

5 a medical imaging apparatus for obtaining volumetric images of the subject;  
means for planning an interventional procedure on a subject using the volumetric images;

a mechanical arm assembly disposed in proximity to the medical imaging apparatus, the mechanical arm assembly comprising a base support, a distal end, a plurality  
10 of arm segments, and a plurality of joints between the arm segments for carrying out the interventional procedure; and

an end-effector disposed at the distal end of the mechanical arm assembly, the end-effector comprising gripping means for selectively gripping and releasing a surgical instrument during the interventional procedure.

15 2. A medical imaging system according to claim 1 wherein the end-effector further comprises:

a first finger portion having a first gripping surface;

20 a second finger portion having a second gripping surface, the first and second gripping surfaces being opposed to one another for applying a gripping force to the surgical instrument;

a first surgical instrument guide disposed on the first finger portion and extending towards the second finger portion; and

25 a second surgical instrument guide disposed on the second finger portion and extending towards the first finger portion.

3. A medical imaging system according to claim 2 further comprising incremental movement means for incrementally inserting the surgical instrument along a trajectory into the subject.

30 4. A medical imaging system according to claim 3 wherein the trajectory is linear.

6. A medical imaging system according to claim 2 wherein the gripping force has a magnitude that allows the surgical instrument to be manually inserted into the subject.

7. A medical imaging system according to claim 2 wherein the first surgical instrument guide applies a first force to the surgical instrument in a direction perpendicular to the first gripping surface and the second surgical instrument guide applies a second force to the surgical instrument in a direction perpendicular to the second gripping surface.

8. A medical imaging system according to claim 7 wherein the first force and the second force are substantially zero.

9. A method of conducting an image-guided medical procedure on a subject, the method comprising:

- generating at least one volumetric image of the subject;
- planning an interventional procedure on the subject using the at least one volumetric image;
- gripping a surgical instrument with an end-effector, the end-effector being disposed at a distal end of a mechanical arm assembly;
- moving the surgical instrument into the subject along a trajectory in accordance with the planned interventional procedure using the mechanical arm assembly; and
- releasing the surgical instrument.

10. A method of conducting an image-guided medical procedure according to claim 9 further comprising the steps of:

- moving the end-effector away from the subject;
- regripping the surgical instrument; and
- moving the surgical instrument further along the trajectory.

11. A method of conducting an image-guided medical procedure according to claim 10 wherein the trajectory is linear.

12. A method of conducting an image-guided medical procedure according to claim 9 wherein the step of gripping comprises the steps of:

applying a gripping force to the surgical instrument using a first gripping surface disposed on a first finger portion of the end-effector and a second gripping surface

5 disposed on a second finger portion of the end-effector; and

stabilizing the surgical instrument using a first instrument guide disposed on the first finger portion and a second instrument guide disposed on the second finger portion.

13. A method of conducting an image-guided medical procedure according to claim 12 wherein the step of stabilizing the surgical instrument has a stabilizing force in a direction perpendicular to the first and second gripping surfaces associated therewith.

14. A method of conducting an image-guided medical procedure according to claim 13 wherein the stabilizing force is substantially zero.

15. A medical imaging system comprising:

imaging means for generating at least one volumetric image of a subject;

planning means for planning an interventional procedure on the subject;

a mechanical arm assembly disposed in proximity to the imaging means, the

20 mechanical arm assembly comprising a base support, a plurality of arm segments, a plurality of joints, and a distal end;

an end-effector disposed at the distal end of the mechanical arm assembly, the end-effector comprising:

a first finger portion having a first gripping surface;

25 a second finger portion having a second gripping surface, the first and second gripping surfaces being opposed to one another for applying a gripping force to a surgical instrument;

a first surgical instrument guide disposed on the first finger portion and extending perpendicularly to the first gripping surface; and

30 a second surgical instrument guide disposed on the second finger portion and extending perpendicularly to the second gripping surface.

16. A medical imaging system according to claim 15 further comprising a mechanical arm controller for controlling the mechanical arm such that the surgical instrument moves along a path in accordance with the planned interventional procedure.

5 17. A medical imaging system according to claim 16 wherein the path comprises a linear trajectory into the subject.

18. A medical imaging system according to claim 17 wherein the movement of the surgical instrument along the path includes relative movement between the surgical  
10 instrument and the end-effector along the linear trajectory.

19. A medical imaging system according to claim 18 further comprising position tracking means for tracking a position of the surgical instrument.

15 20. A medical imaging system according to claim 15 wherein the first surgical instrument guide comprises a first and second prong, the first and second prongs extending past the first gripping surface and the second surgical instrument guide comprises a third and fourth prong, the third and fourth prongs extending past the second gripping surface.